

Crossing Thresholds and Building States: Labor Investment, Tomb Construction, and Early State Formation in the Bronze Age Argolid

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Introduction

It should go without saying that economics and state formation are inextricably linked: the former, at its most basic level, deals with the production, distribution, and consumption of resources, while the latter is governed, to a large extent, by the acquisition of, access to, and control of said resources. For much of its history, archaeology has explored the process of state formation through the lens of economics, focusing in particular on three types of resources that are well-reflected, both directly and indirectly, in the material record: natural, capital, and intellectual. Studies of early state formation in the Bronze Age Argolid, for example, have tended to focus almost exclusively on the artifacts deposited within the various funerary monuments erected throughout the region, using the quantity, quality, sophistication, and diversity of grave goods as material correlates for the wealth, status, and power of emerging elites.¹ Such a focus is not surprising given that archaeology is, at its core, the study of material objects, and that the material objects recovered from these burials are of such an exquisite and spectacular nature. But there exists a fourth type of resource, one that may leave a much subtler trace in the archaeological record, but which plays just as, if not a more, important role in early state formation: human labor. Human labor in the form of specialized craftspeople has featured prominently in such discussions for decades, but in these instances, it is almost always treated from a qualitative perspective, usually as a reflection of some combination of intellectual, capital, and/or natural resources.²

Detailed discussions of non-specialized labor from a purely quantitative perspective, on the other hand, perhaps the most direct reflection of labor as a resource, have, until recently, been relatively rare in archaeological scholarship,³ in large part because this form of labor is much more difficult to access from the material record in the absence of written documentation. Yet its association with state formation is perhaps even stronger than that of specialized craftspeople, and even to some extent, other resources. Indeed, as anthropologists have long recognized, the ability of a society to amass, organize, and direct large pools of human labor is directly correlated with that society's level of socio-political complexity.⁴

This paper explores the relationship between non-specialized human labor and early state formation in the Argolid by examining two forms of elite funerary construction that dominated the region in the Early Mycenaean Period: the shaft grave and the tholos tomb.⁵ Both tomb types served as the primary architectural markers of elite status and competition prior to the erection of the first palace at Mycenae towards the end of the 15th century BC,⁶ with the shaft grave serving as the elite sepulchre of choice during the 18th and 17th centuries,

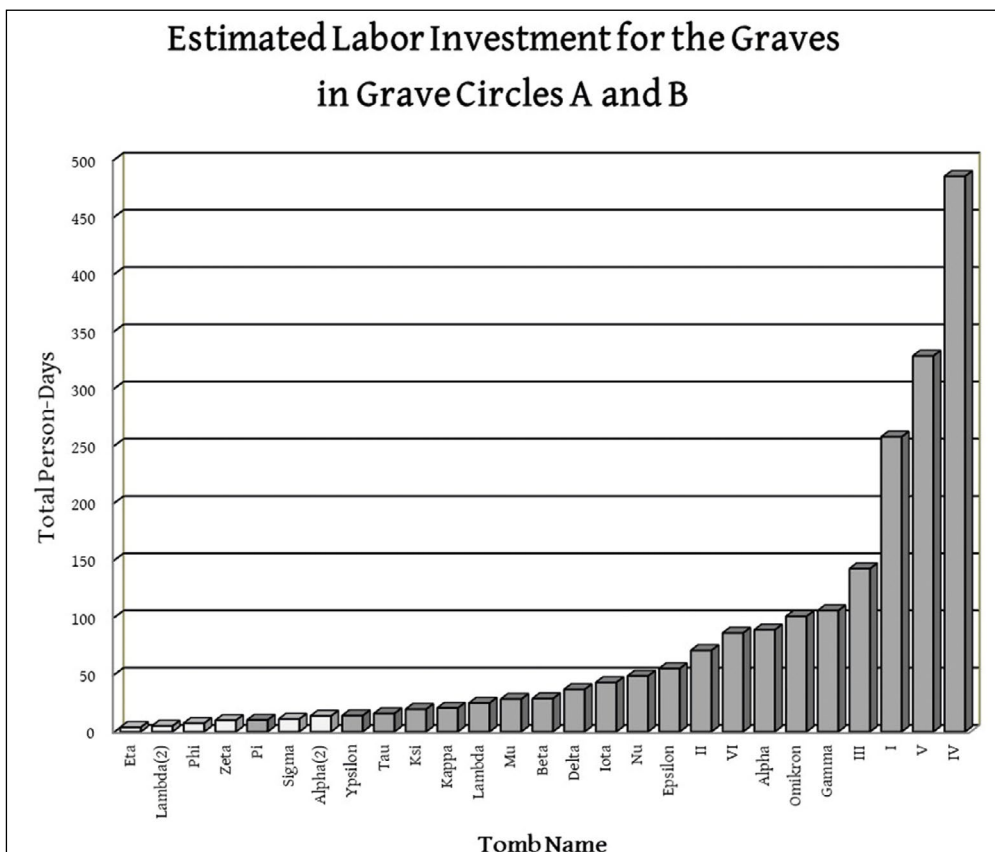


Fig. 1: Bar chart showing estimated labor investment for the construction of cist graves (white) and shaft graves (gray) in Grave Circles A and B.

and the tholos tombs in the 16th and 15th centuries. The analysis presented here combines two theoretical approaches, architectural energetics and social network theory, to explore the relationship between social organization and political power. Further, it proposes that the development of monumental funerary architecture at Mycenae reflects the existence of several discrete stages in the process of early state formation.

Architectural Energetics

As early as the 19th century AD, anthropologists and archaeologists recognized that there is a strong correlation between labor investment, monumentality, and socio-political complexity.⁷ Early approaches to quantifying this relationship were based on the premise that the volume of material required for the construction of any monument served as a direct reflection of the size of the workforce necessary for its construction.⁸ Since larger pools of labor required increasingly complex organizational systems to manage and direct, it followed that larger and larger monuments must have been the products of societies with

<i>Grave</i>	<i>Grave Type</i>	<i>Person-Days for Excavation</i>	<i>Person-Days for Construction</i>	<i>Total Labor Investment</i>
H	cist	3	1	4
Λ2	cist	2	3	5
Φ	cist	4	3	7
Z	cist	7	7	10
Π	shaft	9	1	10
Σ	cist	8	3	11
A2	cist	12	2	14
Y	shaft	13	1	14
T	shaft	13	3	16
Ξ	shaft	15	5	20
K	shaft	19	2	21
Λ	shaft	22	3	25
M	shaft	26	2	28
B	shaft	25	4	29
Δ	shaft	34	3	37
I	shaft	40	3	43
N	shaft	43	6	49
E	shaft	52	3	55
Π	shaft	64	7	71
VI	shaft	79	7	86
A	shaft	86	3	89
O	shaft	94	6	100
Γ	shaft	99	7	106
III	shaft	135	8	143
I	shaft	243	14	237
V	shaft	317	11	328
IV	shaft	467	18	485

Fig. 2: Table showing estimated labor investment for the construction of cist graves and shaft graves in Grave Circles A and B.

higher levels of socio-political complexity. Architectural energetics elaborates on these early volumetric studies by adjusting labor cost estimates which were based on the volume of material used by various factors that affect the length and speed of building activities, such as the distance from the building's site to the material's source, the nature of the terrain, and

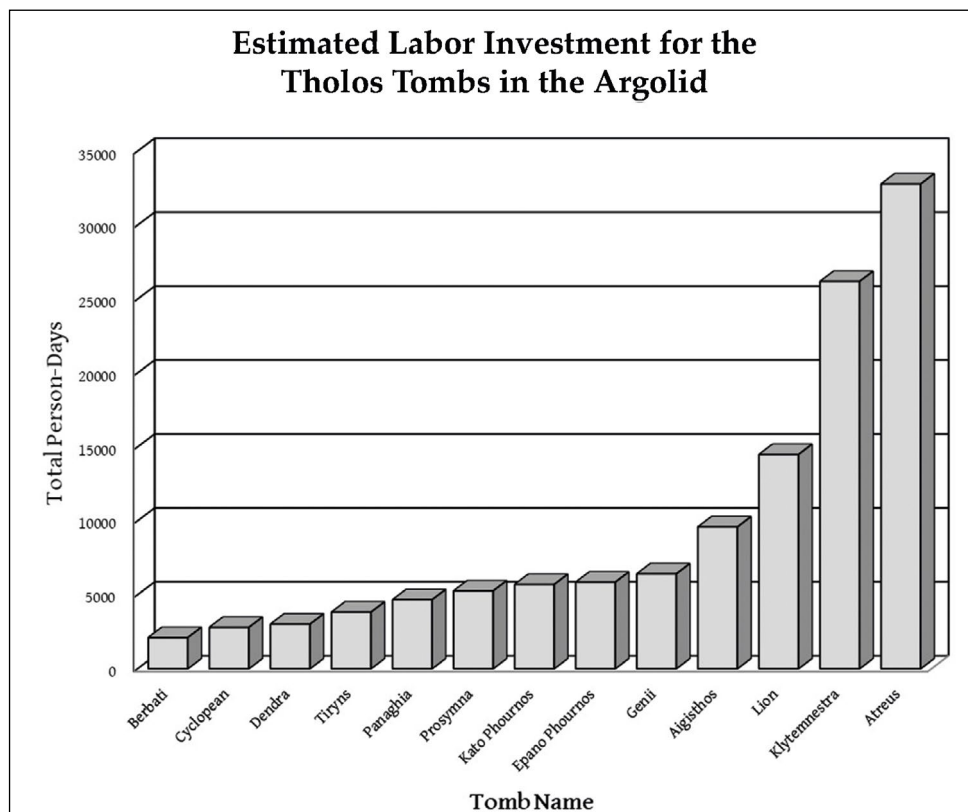


Fig. 3: Bar chart showing estimated labor investment for the construction of tholos tombs in the Argolid.

the difficulty involved in moving, laying, and setting the material.⁹ Abundant data on labor estimates associated with these and other building tasks have been made available since the middle of the last century through the publication of labor studies deriving from civil engineering projects undertaken in developing countries in the decades following World War II,¹⁰ as well as numerous ethnographic explorations of the building capabilities of pre-industrial societies,¹¹ and experimental studies on earthen and stone construction.¹² The publication of these data encouraged further studies in the last decades of the 20th century AD that proved architectural energetics to be a valuable and insightful tool for exploring socio-political complexity.¹³

At its most basic level, architectural energetics estimates the total labor investment required for any building project by multiplying the total volume of each material employed with the observable and reproducible rate of work associated with that material's acquisition, transportation, processing, and construction. The values generated by these calculations, which must be considered minimum values all things considered, can then be converted into standard units of energy, usually expressed as person-hours [p-h] or person-days [p-d] of labor, which serve as quantifiable measurements of the total labor investment required for any constructional undertaking. Moreover, such

<i>Tomb</i>	<i>Date</i>	<i>Largest Lintel Block (tons)</i>	<i>Estimated Workforce</i>	<i>Total Labor Investment (person-days)</i>	<i>Project Time (days)</i>
Berbati	LH IIB-III A:1	1.50	15	2113	141
Cyclopean	early LH IIA	5.07	51	2802	55
Dendra	LH IIB-III A:1	3.06	31	3019	97
Tiryns	LH IIA-B	8.39	84	3833	46
Panaghia	LH IIA-B	11.25	113	4670	42
Prosymna	LH IIB-III A:1	9.55	96	5270	55
Kato Phournos	LH IIA-B	11.66	117	5705	49
Epano Phournos	early LH IIA	13.31	134	5858	44
Genii	LH IIB-III A:1	20.23	203	6423	32
Aigisthos	early LH IIA	8.81	89	9596	108
Lion	LH IIA-B	36.79	368	14496	40
Klytemnestra	LH III A:2-B	34.20	342	26198	77
Atreus	LH III A:2-B	159.54	1596	32789	21

Fig. 4: Table showing estimated labor investment for the construction of tholos tombs in the Argolid based upon the size of the largest lintel blocks. Sufficient data are not available to produce reliable estimates for the tombs at Kazarma or Kokla. Estimated workforce is calculated by multiplying the mass of the largest lintel block by 10 based on 10 men moving one ton. Project time is calculated by dividing the total labor investment (in person-days) by the size of the estimated workforce. The relatively high values obtained for the tombs at Berbati and Dendra and the Tomb of Aigisthos likely result from the significantly smaller size of their lintel blocks, while those obtained for the Treasury of Atreus and the Tomb of Klytemnestra do not seem to conform to the pattern seen elsewhere (Fitzsimons 2014, 96–98).

values allow for direct and objective comparisons of the workforce size required for the completion of building projects undertaken by multiple inter- or intra-cultural groups, and therefore also allow for similar comparisons between the relative levels of socio-political complexity achieved by those groups.

Labor Investment, Population Thresholds, and Socio-political Complexity

The data on which the current study is based have been presented in detail elsewhere,¹⁴ and are summarized in the accompanying charts and tables (figs. 1–8). Two different methods for calculating labor investment are presented here, the first is based on the premise that in order to move a lintel block it takes ten men for each ton (fig. 4),¹⁵

<i>Tomb</i>	<i>Date</i>	<i>Project Time (days)</i>	<i>Total Labor Investment (person-days)</i>	<i>Estimated Workforce</i>
Berbati	LH IIB-III A:1	45	2113	47
Cyclopean	early LH IIA	45	2802	63
Dendra	LH IIB-III A:1	45	3019	68
Tiryas	LH IIA-B	45	3833	86
Panaghia	LH IIA-B	45	4670	104
Prosymna	LH IIB-III A:1	45	5270	118
Kato Phournos	LH IIA-B	45	5705	127
Epano Phournos	early LH IIA	45	5858	131
Genii	LH IIB-III A:1	45	6423	143
Aigisthos	early LH IIA	45	9596	214
Lion	LH IIA-B	45	14496	323
Klytemnestra	LH III A:2-B	45	26198	583
Atrous	LH III A:2-B	45	32789	729

Fig. 5: Table showing estimated labor investment for the construction of tholos tombs in the Argolid based on an estimated time to completion of 45 days. Sufficient data are not available to produce reliable estimates for the tombs at Kazarma or Kokla. Estimated workforce is calculated by dividing the total labour investment by 45 days (Fitzsimons 2014, 97–98).

and the second is based on an average project length of 45 days (fig. 5),¹⁶ which likely produces more reliable estimates. Approximating the number of households necessary to supply these workforces depends upon the size and composition of the household and which recruitment strategies were employed. Unfortunately, there is little information concerning household size and composition for the Bronze Age Aegean, though five individuals per family, a value supported to some extent by ethnographic research into preindustrial families,¹⁷ seems rather plausible.¹⁸ There is a similar dearth of information concerning the recruitment of workforces in the Bronze Age Aegean, though Abrams and Webster as well as Kirker argue that most households would have contributed one laborer to construction projects.¹⁹ For the current study, therefore, it is posited that each household contributed one laborer, and that a relatively reliable estimate of the total workforce size for each project is produced by assuming a construction period lasting 45 days (figs. 7 and 8).

As social and economic theory demonstrates, direct contact between individuals within any group becomes increasingly difficult as that group's population increases, and internal social and political ties begin to break down after a certain population threshold is met.²⁰ At that point, unless the horizontal and vertical relationships

Tomb	Estimated Workforce based on lintels	Population based upon:			
		2 laborers per family of 5	1 laborer per family of 5	laborers representing	
				30% of the population	10% of the population
Berbati	15	38	75	50	150
Dendra	31	78	155	104	310
Cyclopean	51	128	255	170	510
Tiryms	84	210	420	280	840
Tomb of Aigisthos	89	223	445	297	890
Prosymna	96	240	480	320	960
Panaghia	113	283	565	377	1130
Kato Phournos	117	293	585	390	1170
Epano Phournos	134	335	670	447	1340
Genii	203	508	1015	677	2030
Klytemnestra	342	855	1710	1140	3420
Lion	368	920	1840	1267	3680
Atreus	1596	3990	7980	5320	15960

Fig. 6: Table showing estimated size of population pool using a workforce based on the size of the largest lintel blocks. Sufficient data are not available to produce reliable estimates for the tombs at Kazarma or Kokla.

amongst its members are reconfigured, with an increase in socio-political complexity, the system will collapse. Significantly, it is precisely during such periods of political and social stress that large-scale construction projects are often undertaken as a means of maintaining group cohesion.²¹

Drawing upon ethnographic studies and network theory, Kosse has proposed absolute thresholds that signal quantum increases in social complexity once population levels surpass them.²² One such threshold is met when the population reaches 150 +/- 25 individuals.²³ Up until this point, every member of the group is able to maintain strong face-to-face contact with every other member, and information is easily passed between all individuals. Beyond this level, however, while face-to-face relationships are still maintained between all individuals, but knowledge of most members is more cursory and the information flow tends to be regulated through more formal, ritual channels. Interestingly, this threshold seems to coincide with the switch from the shaft grave to the tholos tomb. It is possible to posit, therefore, that the transition to the latter tomb type, which was marked by a significant increase in labor investment, signaled a corresponding increase in the level of socio-political complexity in the region. While it is conceivable that some elite factions were able to draw upon pools based in settlements

Tomb	Estimated Workforce based on 45-day project	Population based upon:			
		2 laborers per family of 5	1 laborer per family of 5	laborers representing	
				30% of the population	10% of the population
SG IV	11	28	55	37	110
Berbati	47	118	235	157	470
Cyclopean	63	158	315	210	630
Dendra	68	170	340	227	680
Tiryns	86	215	430	287	860
Panaghia	104	260	520	347	1040
Prosymna	118	295	590	394	1180
Kato Phournos	127	318	635	424	1270
Epano Phournos	131	328	655	437	1310
Genii	143	358	715	477	1430
Aigisthos	214	535	1070	714	2140
Lion	323	808	1615	1077	3230
Klytemnestra	583	1458	2915	1944	5830
Atreus	729	1823	3645	2430	7290

Fig. 7: Table showing estimated size of population pool using a workforce based on a time to completion of 45 days. Sufficient data are not available to produce reliable estimates for the tombs at Kazarma or Kokla.

elsewhere in the Argolid,²⁴ the fact that the three earliest tholos tombs (the Cyclopean Tomb, the Epano Phournos Tomb, the Tomb of Aigisthos) all appeared at Mycenae itself suggests that their occupants and the workforces they employed were still largely local.

Another such threshold is reached when the population level surpasses 500 +/- 100 individuals, at which point direct face-to-face relationships are impossible to maintain,²⁵ but it is difficult to associate this threshold with any specific socio-political response. Given the increasingly large size of the population pools necessary to supply the required labor forces, however, it is plausible that with the introduction of the tholos tomb in the 16th century, Mycenae itself was no longer able to meet the workforce demand. As a result, the factions responsible for the construction of the tholos tombs began to expand their geographical scope beyond the level of individual sites to operate on a regional scale. At the same time, through the process of peer-polity interaction, new, local factions began to emerge at other settlements, their elite emulating the new style of funerary monument (i.e. the tholos tomb), but on a lesser scale owing to the smaller population pools to which their builders had access.

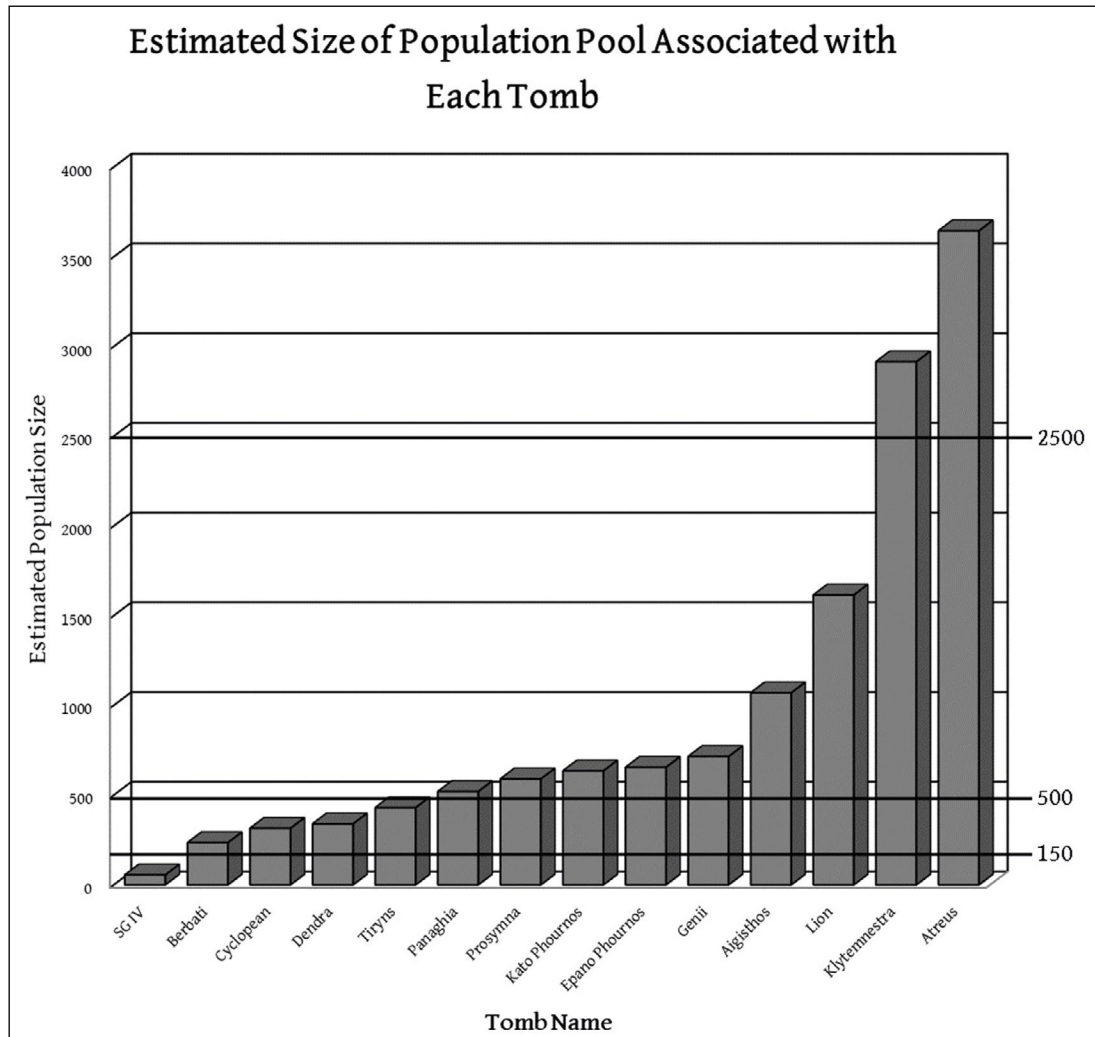


Fig. 8: Bar chart showing estimated size of the population pool associated with each tomb, assuming each household contributed one laborer, as well as Kosse's thresholds.

This discussion of population thresholds and faction size leads us back to the final two tholos tombs constructed in the Argolid, the Treasury of Atreus and the Tomb of Klytemnestra. Following observations made by James C. Wright three decades ago,²⁶ the author has argued elsewhere that these two monuments stand quite apart from the socio-political system embodied by the other tholoi and belong instead to the fully developed palatial administration of the 14th and 13th centuries.²⁷ In terms of building technique, both tombs were the only tholoi in the Argolid to have been rendered entirely in ashlar fashion and to have exclusively incorporated conglomerate, a dense stone that likely required specialized masons to work and that was used to emphasize certain key areas of transition in the 13th century palace.²⁸ In terms of scale, both tombs were constructed on a magnitude far larger than any of the earlier tholoi erected in the

region, not only with respect to overall size (fig. 7), but also with respect to the mass of the individual stones employed. And in terms of physical appearance, they not only incorporated elaborate sculptural details,²⁹ but also may have been designed to mimic the visual effect produced by the contemporary Lion Gate.³⁰

To these observations we can now add two further points of support generated by this energetics analysis: first, the total labor investment required for the construction of these two monuments far outstrips that necessary to erect the other Argive examples (fig. 7) – with the Tomb of Klytemnestra nearly doubling, and the Treasury of Atreus more than doubling, the figures calculated for the next largest tomb (the Lion Tomb). Second, and perhaps more significantly, the estimated populations necessary to supply such labor pools exceeds Kosse's next population threshold of 2500 +/- 500, at which point formal hierarchies begin to emerge (fig. 8).³¹ It is likely no coincidence, therefore, that these two funerary monuments were constructed several generations after the appearance of the first monumental megaron at Mycenae³² – the architectural manifestation par excellence of the Late Bronze Age palace state. Moreover, that the state continued to display its authority through the acquisition, organization, and deployment of human labor is illustrated by the creation of a complex system of roads and bridges across the Argolid, remains of which can be seen at a number of points throughout the region, such as Arkadiko, Drakonera, and Lykotroupi, where the remains of three Cyclopean bridges and the roadways they carried are still clearly visible in the landscape.³³ The regional scale of this construction program and the massive amount of manpower it must have required leave little doubt that it was the product of an early state entity that had the ability to mobilize, organize, direct, and support labor pools magnitudes larger than any that had operated in the past.³⁴

Conclusion

The above discussion is necessarily summary in nature, but it is hoped that it serves to demonstrate that combining architectural energetics and social network theory can provide a valuable mechanism for understanding early state formation at Mycenae. Further, it allows the possibility of identifying more discrete stages in the process of early state formation, of conducting a more detailed examination of the transitions between these stages, and of producing of a much more nuanced picture of the dynamic period that culminated in the appearance of the Mycenaean palace state.

Notes

¹ The bibliography on early state formation in the Argolid is enormous, but for approaches based upon analysis of the grave goods, see Graziadio 1988, 1991; Voutsaki 1995, 1998, 1999, 2001, 2010.

² See, for example, Costin 1991; Henrich – Boyd 2008; Peregrine 1991; Schortman – Urban 2004. For the Aegean, in particular, see, for example, Nakassis 2012, 2015; Nakassis et al. 2016; Parkinson et al. 2013; Pullen 2010.

³ For the Mediterranean, see for example, Burford 1963, 1965; DeLaine 1997; Cavanagh and Mee 1999; Fitzsimons 2006, 2007, 2011, 2014, 2017; Devolder 2012, 2013, 2015, 2017; Brysbaert 2013, 2015a, 2015b; Cook 2014.

⁴ See, for example, Earle 1991; 1997, 85 f. 156 f. 177–179; Fried 1967, 186, 189 f. 207–213; Hayden 1995; Trigger 1990; Wright 1978.

⁵ Fitzsimons 2006; 2007; 2011; 2014.

⁶ All dates presented in this paper are BC.

⁷ See, for example, Udy 1959; Fried 1967; Adams 1975; Wright 1978; Abrams 1984; 1987; 1989; 1994; Trigger 1990; 1995; Webster 1990; Arnold 1993; Hayden 1995; DeMarrais et al. 1996; Abrams – Bolland 1999; Markus 2006.

⁸ See, for example, Squier – Davis 1848; Andrews 1877; Morris et al. 1931. For more recent studies, see, for example, Turner et al. 1981; Cheek 1986; Blitz – Livingood 2004. For brief reference to the history of such studies, see Abrams 1994, 5 f.; Abrams – Bolland 1999, 269–272. For a different perspective, see Moore 1996.

⁹ Abrams 1984; 1987; 1989; 1994; Mathewson 1987, 321 f.; Carmean 1991; Webster 1991, 840; Abrams – Bolland 1999.

¹⁰ ECAFE 1957; 1961; Indian Ministry of Irrigation and Power 1965.

¹¹ See, for example, Pulver 1947; Barrau 1958; 1961; Redfield – Villa Rojas 1962; Pospisil 1963; Lerche – Steenburg 1973; Gorecki 1985; Blier 1987.

¹² Atkinson 1961; Erasmus 1965; Coles 1979, 131–158.

¹³ See, for example, Puleston 1977; Turner 1983; Golson – Steenburg 1985; Turner – Denevan 1985, 15–16; Abrams 1994, 41–52.

¹⁴ Fitzsimons 2006, 26–194; 2011; 2014.

¹⁵ Fitzsimons 2014, 95–97.

¹⁶ Fitzsimons 2014, 97 f.

¹⁷ Redfield and Villa Rojas 1962, 91; Erasmus 1965, 294; Laslett 1971, 66; Beauroy 1986, 27; Blier 1987, 142; see Pospisil 1963, 59 and Cohen 1975, however, for larger family sizes, and Ruggles 2009 for a review of recent discussions on the preindustrial family.

¹⁸ Webster – Kirker 1995, 374–379; Clare 2010, 250.

¹⁹ Abrams 1987, 493; 1994, 42; Webster – Kirker 1995, 375 f. For reference to labor pools being organized along kinship lines, see Mosely 1975; Sanders – Webster 1978, 274; Abrams 1987, 494–496; Abrams and Bolland 1999, 286 f.

²⁰ See, for example, Simon 1962; Ember 1963; Carneiro 1967; 1978; Bernard – Killworth 1973; Johnson 1978; 1982; Kosse 1990; 1994; Feinman 1998.

²¹ See, for example, McGuire – Schiffer 1983; Oliveira 1986, 106; Abrams 1989, 63; 1994, 92; Trigger 1990, 127; Adams 1992, 216; Kolb 1994, 521. 527–533; 1997, 279; Clare 2010, 250; Fitzsimons 2011, 100; 2014, 100.

²² Kosse 1990; 1994; 1996; 2000. Interestingly, because these thresholds appear to be related to the limitations of short-term memory and human neurobiology, they are universal rather than culture-specific.

²³ Kosse 1990, 284; 1996; 2000, 62. Kosse (1994, 38) has also proposed an even smaller threshold on the order of 10–12 individuals.

²⁴ Isotope analyses of some of the skeletal remains from Grave Circle A are less than conclusive, but Nafplioti (2009) has suggested that at least some of the females were non-local, perhaps participants in marriage alliances that were formed between high-status families resident at and beyond Mycenae.

²⁵ Kosse 1990, 276 f. 281; 1996; 2000, 62 f. See also Carneiro 1978; Feinman 1998, 104–109.

²⁶ Wright 1987.

²⁷ Fitzsimons 2006, 190 f.; 2007, 113 f.; 2011, 110 f.; 2014, 95.

²⁸ Wright 1987, 177. 183; Blackwell 2014; 2018; Fitzsimons 2019.

²⁹ For the Treasury of Atreus, see Ellis et al. 1968; Younger 1987; Cavanagh – Mee 1999, 98; Fitzsimons 2006, 133. For the Tomb of Klytemnestra, see Wace 1949, 36; Mylonas 1957, 93; Fitzsimons 2006, 142.

³⁰ Wace 1921–23, 253; 1949, 133; Mylonas 1957, 87 f.; 1966, 122; Wright 1987. Wace and Mylonas were so convinced of the similarity between the Treasury of Atreus and the Lion Gate that they suggested that both were constructed by the same ruler. The similarity between these constructions, which may admittedly be over-emphasized in the literature, is based on both the post-and-lintel construction and the heavy use of coursed, conglomerate ashlar in the flanking walls, a building technique which contrasts rather strongly with the polygonal sections of walling flanking the Lion Gate.

³¹ Kosse 1990, 287; 1996; 2000, 62 f.

³² For a detailed discussion of the date of these tombs, with references, see Fitzsimons 2006, 136 f. 143 f. 228–274. 292–302; 2007; 2011.

³³ Crouwel 1981; Hope Simpson 1998; 2002; Hope Simpson – Hagel 2006; Jansen 1994; 1997; 2002; Mylonas 1966, 86–88. Projects of a similar scale to those listed here include the construction of involved the erection of a stone-lined earthen dike – the so-called Tiryns Dam – and the excavation of a new river channel to divert the course of the Manessi River away from the acropolis at Tiryns and protect it from the periodic, devastating floods that had struck the settlement throughout its history (Balcer 1974; Zangger 1994), the construction of an artificial port near Romanou in Messenia (Davis – Bennet 1999, 106 f.; Zangger et al. 1997, 631 f.), and the construction of a series of drainage channels that drained the Kopaic Basin near Thebes (Knauss 1989; Knauss et al. 1984).

³⁴ Fitzsimons 2007, 113; 2011, 109 f.

Image Credits

Fig. 1–3: based on data from Fitzsimons 2014. – Fig. 4–7: after Fitzsimons 2014, Table 4. – Fig. 8: by the author.

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